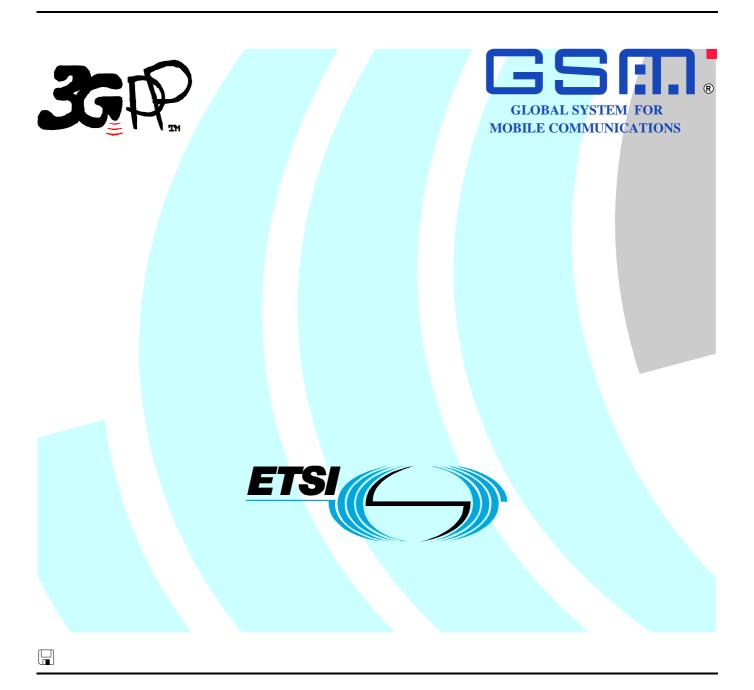
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Technical Specification

Digital cellular telecommunications system (Phase 2+);
Universal Mobile Telecommunications System (UMTS);
ANSI-C code for the Adaptive Multi-Rate Wideband (AMR-WB) speech codec
(3GPP TS 26.173 version 6.3.0 Release 6)



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1 Scope

The present document contains an electronic copy of the ANSI-C code for the Adaptive Multi-Rate Wideband codec. The ANSI-C code is necessary for a bit exact implementation of the Adaptive Multi Rate Wideband speech transcoder (3GPP TS 26.190 [2]), Voice Activity Detection (3GPP TS 26.194 [6]), comfort noise (3GPP TS 26.192 [4]), source controlled rate operation (3GPP TS 26.193 [5]) and example solutions for substituting and muting of lost frames (3GPP TS 26.191 [3]).

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
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- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.
- [1] 3GPP TS 26.174: "AMR Wideband Speech Codec; Test sequences". [2] 3GPP TS 26.190: "AMR Wideband Speech Codec; Speech transcoding". 3GPP TS 26.191: "AMR Wideband Speech Codec; Substitution and muting of lost frames". [3] [4] 3GPP TS 26.192: "AMR Wideband Speech Codec; Comfort noise aspects". 3GPP TS 26.193: "AMR Wideband Speech Codec; Source controlled rate operation". [5] [6] 3GPP TS 26.194: "AMR Wideband Speech Codec; Voice Activity Detection". RFC 3267 'A Real-Time Transport Protocol (RTP) Payload Format and File Storage Format for [7] Adaptive Multi-Rate (AMR) and Adaptive Multi-Rate Wideband (AMR-WB) Audio Codecs, June 2002.

3 Definitions and abbreviations

3.1 Definitions

Definition of terms used in the present document, can be found in 3GPP TS 26.190 [2], 3GPP TS 26.191 [3], 3GPP TS 26.192 [4], 3GPP TS 26.193 [5] and 3GPP TS 26.194 [6].

3.2 Abbreviations

For the purpose of the present document, the following abbreviations apply:

AMR-WB	Adaptive Multi-Rate Wideband
ANSI	American National Standards Institute
ETS	European Telecommunication Standard
GSM	Global System for Mobile communications
I/O	Input/Output

RAM Random Access Memory ROM Read Only Memory

4 C code structure

This clause gives an overview of the structure of the bit-exact C code and provides an overview of the contents and organization of the C code attached to this document.

The C code has been verified on the following systems:

- Sun Microsystems workstations and GNU gcc compiler
- HP workstations and cc compiler
- IBM PC compatible computers with Windows NT4 operating system and GNU gcc compiler.

ANSI-C was selected as the programming language because portability was desirable.

4.1 Contents of the C source code

The C code distrubution has all files in the root level.

The distributed files with suffix "c" contain the source code and the files with suffix "h" are the header files. The ROM data is contained mostly in files with suffix "tab".

The C code distribution also contains one speech coder installation verification data file, "spch_dos.inp". The reference encoder output file is named "spch_dos.cod", the reference decoder input file is named "spch_dos.dec" and the reference decoder output file is named "spch_dos.out". These four files are formatted such that they are correct for an IBM PC/AT compatible computer. The same files with reversed byte order of the 16 bit words are named "spch_unx.inp", "spch_unx.cod", "spch_unx." and "spch_unx.out", respectively.

Final verification is to be performed using the GSM Adaptive Multi-Rate Wideband test sequences described in 3GPP TS 26.174 [1].

Makefiles are provided for the platforms in which the C code has been verified (listed above). Once the software is installed, this directory will have a compiled version of *encoder* and *decoder* (the bit-exact C executables of the speech codec) and all the object files.

4.2 Program execution

The GSM Adaptive Multi-Rate Wideband codec is implemented in two programs:

- (encoder) speech encoder;
- (decoder) speech decoder.

The programs should be called like:

- encoder [encoder options] <speech input file> <parameter file>;
- decoder <parameter file> <speech output file>.

The speech files contain 16-bit linear encoded PCM speech samples and the parameter files contain encoded speech data and some additional flags.

The encoder and decoder options will be explained by running the applications without input arguments. See the file readme.txt for more information on how to run the *encoder* and *decoder* programs.

4.3 Code hierarchy

Tables 1 to 3 are call graphs that show the functions used in the speech codec, including the functions of VAD, DTX, and comfort noise generation.

Each column represents a call level and each cell a function. The functions contain calls to the functions in rightwards neighboring cells. The time order in the call graphs is from the top downwards as the processing of a frame advances.

All standard C functions: printf(), fwrite(), etc. have been omitted. Also, no basic operations (add(), $L_add()$, mac(), etc.) or double precision extended operations (e.g. $L_Extract()$) appear in the graphs. The initialization of the static RAM (i.e. calling the _init functions) is also omitted.

The basic operations are not counted as extending the depth, therefore the deepest level in this software is level 6.

The encoder call graph is broken down into two separate call graphs, Table 1 to 2.

Table 1: Speech encoder call structure

Con		1		
Cop	oim_12k8	Down_samp	Interpol (function)	1
1000	5III_12R0	Сору	interper (raneuerr)	1
Set	_zero	- 17	_	
	 50_12k8	1		
Sca	ale_sig			_
wb_	_vad	Filter_bank	Filter5	1
			Filter3	1
			Level_calculation	1
		vad_decision	llog2	
			Noise_estimate_update	update_cntrl
			hangover_addition	
	de la caralla a	Estimate_Speech	_	
	dtx_handler	-		
	m_serial ocorr	1		
	_window			
	rinson	i		
Az_		Chebps2	7	
Int_i		Isp_Az	Get_isp_pol	1
lsp_				•
Gp_	_clip_test_isf			
Wei	ight_a			
Res				
	emph2			
	_Decim2			
	ale_mem_Hp_wsp		7	
Pitc	ch_med_ol	Hp_wsp	4	
<u> </u>	real tops detects	Isqrt_n	_	
	_vad_tone_detection	modionE	7	
	d_olag	median5	4	
	_buffer _enc	Copy Find_frame_indices	4	
uix_	_0.10	Aver_isf_history	=	
		Qisf_ns	Sub_VQ	1
		Q101_110	Disf_ns	Reorder isf
		Parm serial		
		Pow2		
		Random		
		Dot_product12		
		lsqrt_n		
lsf_i			_ =	
lsp_		Get_isp_pol		
Syn	nthesis	Сору		
		Syn_filt_32	<u></u>	
		Deemph_32	4	
		HP50_12k8	4	
		Random		
		Random Scale_sig	- - -	
		Random Scale_sig Dot_product12	- - - -	
		Random Scale_sig Dot_product12 Isqrt_n	- - - -	
		Random Scale_sig Dot_product12 Isqrt_n HP400_12k8		
		Random Scale_sig Dot_product12 Isgrt_n HP400_12k8 Weight_a		
		Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt		
Res	set encoder	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k		
Res	set_encoder	Random Scale sig Dot_product12 Isgrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero		
Res	set_encoder	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k	Set_zero	1
	set_encoder isf_2s_36b	Random Scale_sig Dot_product12 lsgrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero lnit_gp_clip lnit_Phase_dispersion VQ_stage1	Set_zero	1
		Random Scale sig Dot_product12 Isgrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_gp_clip Init_Phase_dispersion VQ Stage1 Sub_VQ Sub_VQ]
Qpis	sf_2s_36b	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_gp_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_28_36b	Set_zero Reorder_isf]
Qpis		Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_gp_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1]
Qpis	sf_2s_36b	Random Scale_sig Dot_product12 Isgrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_gp_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Stage1 Sub_VQ	Reorder_isf	
Qpis Qpis	sf_2s_36b sf_2s_46b	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_gp_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1]]]
Qpis Qpis	sf_2s_36b sf_2s_46b filt	Random Scale_sig Dot_product12 Isgrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_gp_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Stage1 Sub_VQ	Reorder_isf]]]
Qpis Qpis Syn	sf_2s_36b sf_2s_46b o_filt emph2	Random Scale_sig Dot_product12 Isgrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_pp_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b	Reorder_isf Reorder_isf	
Qpis Qpis Syn	sf_2s_36b sf_2s_46b filt	Random Scale_sig Dot_product12 Isgrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_gp_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Stage1 Sub_VQ	Reorder_isf Reorder_isf Convolve]
Qpis Qpis Syn	sf_2s_36b sf_2s_46b o_filt emph2	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_g_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr	Reorder_isf Reorder_isf	
Qpis Qpis Syn Pree Pitcl	sf_2s_36b sf_2s_46b n_filt emph2 ch_fr4	Random Scale_sig Dot_product12 Isgrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_pp_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b	Reorder_isf Reorder_isf Convolve	
Qpis Qpis Syn Pres Pitci	sf_2s_36b sf_2s_46b _filt emph2 -h_fr4 _clip	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_g_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr	Reorder_isf Reorder_isf Convolve	
Qpis Qpis Syn Prec Pitci Gp Prec	sf_2s_36b sf_2s_46b s_filt emph2 ch_fr4 clip d_lt4	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_g_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr	Reorder_isf Reorder_isf Convolve	
Qpis Qpis Syn Prec Pitci Gp_ Prec Con	sf_2s_36b sf_2s_46b n_filt emph2 ch_fr4clip d_lt4 nvolve	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_gp_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr Interpol_4	Reorder_isf Reorder_isf Convolve	
Qpis Syn Pres Pitci Gp_ Pres Con G_p	sf_2s_36b sf_2s_46b filt emph2 ch_fr4 clipd_t4volvebitch	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_g_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr	Reorder_isf Reorder_isf Convolve	
Qpis Syn Pree Pitc Gp Prec Con G_p Upd	isf_2s_36b isf_2s_46b i_filt emph2 ch_fr4 clip d_lt4 volve bitch tt_tar	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_gp_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr Interpol_4	Reorder_isf Reorder_isf Convolve	
Qpis Syn Prec Pitci Gp Prec Con G_p Upda	sf_2s_36b sf_2s_46b n_filt emph2 th_fr4 clip d_lt4 nvolve pitch tt_tar emph	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_gp_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr Interpol_4	Reorder_isf Reorder_isf Convolve	
Qpis Syn Prec Pitc Gp_ Prec Con G_p Upd Prec	sf_2s_36b sf_2s_46b n_filt emph2 ch_fr4 _clip d_lt4 tvolve pitch tt_tar emph _shrp	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_gp_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr Interpol_4	Reorder_isf Reorder_isf Convolve	
Qpis Qpis Syn Prec Pitc Gp Prec Con G p Upd Pret Pit	sf_2s_36b sf_2s_46b sf_2s_46b n_filt emph2 ch_fr4 clip d_lt4 ivolve pitch dt_tar emph _shrp _h_x	Random Scale_sig Dot_product12 Isgrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_p_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr Interpol_4 Dot_product12	Reorder_isf Reorder_isf Convolve	
Qpis Qpis Syn Prec Pitc Gp Prec Con G p Upd Pret Pit	sf_2s_36b sf_2s_46b n_filt emph2 ch_fr4 _clip d_lt4 tvolve pitch tt_tar emph _shrp	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_gp_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr Interpol_4 Dot_product12 Dot_product12	Reorder_isf Reorder_isf Convolve	
Qpis Syn Pret Pitci Gp_ Pret Con G_p Upda Pret Pit_ Cor ACE	sf_2s_36b sf_2s_46b sf_2s_46b n_filt emph2 th_fr4 clip d_tt4 rvolve pitch dt_tar emph shrp h_x ELP_2t64_fx	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_g_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr Interpol_4 Dot_product12 Isqrt_n	Reorder_isf Reorder_isf Convolve	
Qpis Syn Prec Pitc Gp_ Prec Con G_p Upd Prec Pit_ Cor ACE	sf_2s_36b sf_2s_46b n_filt emph2 ch_fr4 clip d_lt4 nvolve pitch tt_tar emph _shrp _h_x ELP_2t64_fx ELP_4t64_fx	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_pelip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr Interpol_4 Dot_product12 Isqrt_n See Table 2	Reorder_isf Reorder_isf Convolve	
Qpis Syn Pret Pitc Gp Pret Con G_p Upd Pret Pit_ Cor ACE	sf_2s_36b sf_2s_46b sf_2s_46b n_filt emph2 th_fr4 clip d_tt4 rvolve pitch dt_tar emph shrp h_x ELP_2t64_fx	Random Scale_sig Dot_product12 Isgrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_p_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr Interpol_4 Dot_product12 Isgrt_n See_Table 2 Dot_product12 Dot	Reorder_isf Reorder_isf Convolve	
Qpis Syn Pret Pitci Gp Pret Con G p Upda Pret ACE ACE	sf_2s_36b sf_2s_46b sf_2s_46b sf_filt emph2 ch_fr4 clip d_lt4 nvolve poitch st_tar emph shrp '_h_x ELP_2t64_fx ELP_4t64_fx gain2	Random Scale_sig Dot_product12 Isqrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_pelip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr Interpol_4 Dot_product12 Isqrt_n See Table 2	Reorder_isf Reorder_isf Convolve	
Qpis Syn Pred Pitc Gp_ Pred Pred Con G_p Upd Pret Cor ACE Q_g Gp_	sf_2s_36b sf_2s_46b n_filt emph2 ch_fr4 clip d_lt4 nvolve pitch tt_tar emph _shrp _h_x ELP_2t64_fx ELP_4t64_fx	Random Scale_sig Dot_product12 Isgrt_n HP400_12k8 Weight_a Syn_filt Filt_6k_7k Set_zero Init_p_clip Init_Phase_dispersion VQ_stage1 Sub_VQ Dpisf_2s_36b VQ_stage1 Sub_VQ Dpisf_2s_46b Norm_Corr Interpol_4 Dot_product12 Isgrt_n See_Table 2 Dot_product12 Dot	Reorder_isf Reorder_isf Convolve	

Table 2: ACELP_4t64_fx call structure

ACELP_4t64_fx	Dot_product12			
	Isqrt_n			
	cor_h_vec			
	search_ixiy			
	quant_1p_N1			
	quant_2p_2N1			
	quant_3p_3N1	quant_2p_2N1		
		quant_1p_N1		
	quant_4p_4N	quant_4p_4N1	Quant_2p_2N1	
		quant_1p_N1		
		quant_3p_3N1	Quant_2p_2N1	
			Quant_1p_N1	
		quant_2p_2N1		
	quant_5p_5N	quant_3p_3N1	Quant_2p_2N1	
			Quant_1p_N1	
		quant_2p_2N1		
	quant_6p_6N_2	quant_5p_5N	Quant_3p_3N1	quant_2p_2N1
				Quant_1p_N1
			quant_2p_2N1	
		quant_1p_N1		
		quant_4p_4N	quant_4p_4N1	quant_2p_2N1
			quant_1p_N1	
			quant_3p_3N1	quant_2p_2N1
				quant_1p_N1
			quant_2p_2N1	
		quant_2p_2N1		<u> </u>
		quant_3p_3N1	quant_2p_2N1	
			Quant_1p_N1	

Rx_dtx_handler

decoder

Copy Disf_ns Reorder_isf Serial_parm Random Dot_product12 lsqrt_n Serial_parm Isf_isp Isp_Az Get_isp_pol Сору Copy Syn_filt_32 Deemph_32 HP50_12k8 Synthesis Oversamp_16k Copy Up_samp Interpol Random Scale sig Dot_product12 Isqrt_n HP400_12k8 Isf_Extrapolation Isp_Az Weight_a Get isp pol Syn_filt Filt 6k 7k Copy Filt_7k Copy Reset_decoder Init_Phase_dispersion Set_zero Dpisf_2s_36b Dpisf_2s_46b Reorder_isf Reorder_isf Get_isp_pol Int_isp Isp_Az insertion_sort Random Pred_lt4 Random DEC_ACELP_2t64_fx DEC_ACELP_4t64_fx dec_1p_N1 add_pulses dec_2p_2N1 dec_3p_3N1 Dec_2p_2N1 dec_1p_N1 dec_4p_4N dec_4p_4N1 dec_2p_2N1 dec_1p_N1 Dec_3p_3N1 Dec_2p_2N1 Dec_1p_N1 Dec_2p_2N1 dec_3p_3N1 dec_5p_5N Dec 2p 2N1 Dec_1p_N1 Dec_2p_2N1 dec_6p_6N_2 dec_3p_3N1 Dec_2p_2N1 dec_2p_2N1 dec_1p_N1 dec_4p_4N dec 4p 4N1 dec_2p_2N1 dec 1p N1 Dec_3p_3N1 Dec_2p_2N1 Dec_2p_2N1 dec_2p_2N1 dec_3p_3N1 Dec_2p_2N1 Dec_1p_N1 Preemph Pit_shrp D_gain2 Dot_product12 Isqrt_n Median5 Pow2 Scale_sig Dot_product12 voice factor Phase_dispersion Set_zero Isqrt Isgrt n Set_zero Dtx_dec_activity_update

Table 3: Speech decoder call structure

4.5 Variables, constants and tables

The data types of variables and tables used in the fixed point implementation are signed integers in 2's complement representation, defined by:

- Word16 16 bit variable;
- Word32 32 bit variable.

4.5.1 Description of constants used in the C-code

This subclause contains a listing of all global constants defined in cnst.h.

Table 5: Global constants

Constant	Value	Description
L_TOTAL	384	total size of speech buffer.
L_WINDOW	384	window size in LP analysis
L_NEXT	64	Look-ahead size
L_FRAME	256	frame size in 12.8 kHz
L_FRAME16k	320	frame size in 16 kHz
L_SUBFR	64	Subframe size in 12.8 kHz
L_SUBFR16k	80	Subframe size in 16 kHz
NB_SUBFR	4	Number of subframes
M16k	20	order of LP filter in high-band synthesis in 6.60 mode
M	16	order of LP filter
L_FILT16k	15	Delay of down-sampling filter in 16 kHz
L_FILT	12	Delay of down-sampling filter in 12.8 kHz
GP_CLIP	15565	Pitch gain clipping
PIT_SHARP	27853	pitch sharpening factor
PIT_MIN	34	minimum pitch lag (all modes)
PIT_FR2	128	Minimum pitch lag with resolution ½
PIT_FR1_9b	160	Minimum pitch lag with resolution for 9 bit quantization
PIT_FR1_8b	92	Minimum pitch lag with resolution for 8 bit quantization
PIT_MAX	231	maximum pitch lag
L_INTERPOL	(16+1)	length of filter for interpolation
OPL_DECIM	2	Decimation in open-loop pitch analysis
PREEMPH_FAC	22282	preemphasis factor
GAMMA1	30147	Weighting factor (numerator)
TILT_FAC	22282	tilt factor (denominator)
Q_MAX	8	scaling max for signal
RANDOM_INITSEED	21845	random init value
L_MEANBUF	3	Size of ISF buffer
ONE_PER_MEANBUF	10923	Inverse of L_MEANBUF

4.5.2 Description of fixed tables used in the C-code

This section contains a listing of all fixed tables sorted by source file name and table name. All table data is declared as **Word16**.

Table 6: Fixed tables

File	Table name	Length	Description
C4t64fx.c	Tipos	36	starting points of iterations
	HP_gain	16	High band gain table for 23.85 kbit/s mode
	Interpol_frac	4	LPC interpolation coefficients
	Isp_init	16	isp tables for initialization
Cod_main.c	Isf_init	16	isf tables for initialization
D_gain2.c	cdown_unusable	7	attenuation factors for codebook gain in lost frames
D_gain2.c	cdown_usable	7	attenuation factors for codebook gain in bad frames
	pdown_unusable	7	attenuation factors for adaptive codebook gain in lost frames
•	pdown_usable	7	attenuation factors for adaptive codebook gain in bad frames
	Pred	4	algebraic code book gain MA predictor coefficients
	HP_gain	16	High band gain table for 23.85 kbit/s mode
	Interpol_frac	4	LPC interpolation coefficients
	Isp_init	16	isp tables for initialization
	Isf_init	16	isf tables for initialization
	fir_down	120	Downsample FIR filter coefficients
	fir_up	120	Upsample FIR filter coefficients
	en_adjust	9	Energy scaling factor for each mode during comfort noise
	grid	101	grid points at wich Chebyshev polynomials
	Window	384	LP analysis window
Hp400.c	A	3	HP filter coefficients (denominator) in higher band energy estimation
	В	3	HP filter coefficients (numerator) in higher band energy estimation
Hp50.c	A	3	HP filter coefficients (denominator) in pre-filtering
Hp50.c	В	3	HP filter coefficients (numerator) in pre-filtering
	Fir_6k_7k	31	Bandpass FIR filter coefficients for higher band generation
	Fir_7k	31	Bandpass FIR filter coefficients for higher band in 23.85 kbit/s mode
Hp_wsp.c	Α _	3	HP filter coefficients (denominator) in open-loop lag gain computation
	В	3	HP filter coefficients (numerator) in open-loop lag gain computation
	slope	128	table to compute cos(x) in Lsf_lsp()
lsp_isf.tab	Table	129	table to compute acos(x) in Lsp_lsf()
	lag_h	16	high part of the lag window table
-	lag_l	16	low part of the lag window table
	h_fir	5	HP FIR filter coefficients in open-loop lag search
	table_isqrt	49	table used in inverse square root computation
	table_pow2	33	table used in power of two computation
	Corrweight	199	weighting of the correlation function in open loop LTP search
	ph_imp_low	64	phase dispersion impulse response
	ph_imp_mid	64	phase dispersion impulse response
Pitch_fr4.c	inter4_1	32	interpolation filter coefficients
	inter4_2	128	interpolation filter coefficients
Q_gain2.c	pred	4	algebraic code book gain MA predictor coefficients
	t_qua_gain6b	2*64	gain quantization table for 6-bit gain quantization
Q_gain2.tab	t_qua_gain7b	2*128	gain quantization table for 7-bit gain quantization
	dico1_isf_noise	2*64	1 st ISF quantizer for comfort noise
Qisf_ns.tab	dico2_isf_noise	3*64	2 nd ISF quantizer for comfort noise
Qisf_ns.tab	Dico3_isf_noise	3*64	3 rd LSF quantizer for comfort noise
Qisf_ns.tab	Dico4_isf_noise	4*32	4 th LSF quantizer for comfort noise
	Dico5_isf_noise	4*32	5 th LSF quantizer for comfort noise
	mean_isf_noise	16	ISF mean for comfort noise
	dico1_isf	9*256	1 st ISF quantizer of the 1 st stage
	Dico2_isf	7*256	2 nd ISF quantizer of the 1 st stage
Qpisf_2s.tab	Dico21_isf	3*64	1st ISE quantizer of the 2 nd stage (not the 6.60 kbit/s mode)
Qpisf_2s.tab	Dico21_isf_36b	5*128	1st ISF quantizer of the 2 nd stage (the 6.60 kbit/s mode)
Qpisf_2s.tab	Dico22_isf	3*128	2 nd ISF quantizer of the 2 nd stage (not the 6.60 kbit/s mode) 2 nd ISF quantizer of the 2 nd stage (the 6.60 kbit/s mode)
Qpisf_2s.tab	Dico22_isf_36b	4*128	2 nd ISF quantizer of the 2 nd stage (the 6.60 kbit/s mode)

(continued)

Table 6 (concluded): Fixed tables

File	Table name	Length	
Qpisf_2s.tab	Dico23_isf	3*128	3 rd ISF quantizer of the 2 nd stage (not the 6.60 kbit/s mode)
Qpisf_2s.tab	Dico23_isf_36b	7*64	3 rd ISF quantizer of the 2 nd stage (the 6.60 kbit/s mode)
Qpisf_2s.tab	Dico24_isf	3*32	4 th ISF quantizer of the 2 nd stage (not the 6.60 kbit/s mode)
Qpisf_2s.tab	Dico25_isf	4*32	5 th ISF quantizer of the 2 nd stage (not the 6.60 kbit/s mode)
Qpisf_2s.tab	Mean_isf	16	ISF mean

4.5.3 Static variables used in the C-code

In this section two tables that specify the static variables for the speech encoder and decoder respectively are shown. All static variables are declared within a C **struct.**

Table 7: Speech encoder static variables

ol_wght_flg old_ol_alg word16[5] Open loop lag history Open-loop lag gain filter memory Open-loop lag history Open-loop lag sin filter memory Open-loop lag history See below in this table First frame indicator Old ISP vector Noise enhancer threshold Synthesis filter memory (least significant word Noise enhancer threshold Noise enhancer thresh	Struct name	Variable	Type[Length]	Description
mem_preemph old_speech old_wsp old_wsp old_wsp old_exc word16[14] nem_levinson lspold word16[18] lspold word16[18] lspold word16[18] lspold word16[16] past_istq mem_decm2 word16[16] mem_desm2 mem_decm2 mem_decm2 word16[16] mem_desm3 word16[16] mem_msyn word16 mem_syn word16 mem_syn word16 old_wsp_max word16 old_wsp_shift old_dwsp_shift old_lsp word16[16] qua_gain word16[16] qua_gain word16[16] old_lsp word16 old_wsp_max word16[16] qua_gain word16[16] nem_decm2 word16[16] qua_gain word16[16] nem_decm3 word16[16] qua_gain word16[16] old_lsp word16[16] old_lsp word16[16] old_lsp word16[16] nem_syn_bi word16 old_wsp_max word16[16] nem_syn_bi word16[16] nem_syn_bi word16[16] nem_syn_bi word16[16] nem_oversamp word16[16] mem_bf2 mem_syn_bi mem_bf3 word16[16] mem_hf2 word16[16] mem_hf3 word16[16] mem_hf3 word16[16] mem_hf3 word16[16] mem_hf4 word16[16] mem_hf4 word16[16] mem_hf5 word16[16] mem_hf5 word16[16] mem_hf6 word16[16] mem_hf7 word16[16] mem_hf7 word16[16] mem_hf8 word16[16] mem_hf8 word16[16] mem_hf8 word16[16] mem_hf9 word16[16] mem_hf8 word16[16] mem_hf9 word16[16] mem_hf8 word16[16] mem_hf9 word16[16] mem_hf9 word16[16] mem_hf8 word16[16] mem_hf9 word16[16] mem_hf9 word16[16] mem_hf9 word16[16] mem_hf9 word16[16] mem_hf9 word16[16] mem_hf9 word16[16] mem_hf8 word16[16] mem_hf9 wo	Coder_State			
old_speech Word16 128 old_exc Word16 148 old_exc Word16 148 mem levinson Word16 148 lspold Word16 16 past_istq Word16 16 past_istq Word16 16 past_istq Word16 16 mem_decim2 Word16 16 mem_syn Word16 Preemhasis filter memory Word16 Q_max Word16 Q_max Word16 Qain quantization memory Word16 Qill_qua_gain Word16 Qill_q		•		
old_exc Word16[14] word16[14] word16[14] lispold_q word16[14] lispold_q word16[14] word16[14] past_isfq word16[14] mem_wep word16[14] mem_decim2 word16[14] mem_decim2 word16[14] mem_syn word16[14] word16[14] word16[15] mem_syn word16[14] word16[15] word16[15] word16[16] word16[
old_exc mem_levinson mem_levinson lspold word16[16] lspold word16[16] past_isfq mem_wsp		- I		
mem_levinson Word16[18] Levinson memories Old ISP vector past Isrlq word16[16] mem_wsp Word16[13] mem_wsp Word16[3] mem_wsp Word16[3] Open-loop LTP decimation filter memory Open-loop LTP decimation filter memory Open-loop LTP decimation filter memory Word16[3] open-loop LTP decimation filter memory Word16[3] word16[3				
Ispold				
ispold, q past_isfg past_isfg word16[16] past_usfg mem_wsp Word16 mem_wsp Word16 mem_decin2 word16[3] mem_decin2 word16[3] mem_syn Word16[3] mem_syn Word16[16] weighting filter memory (applied to error signa synthesis filter memory (applied to error stational synthesis filter memory (applied to error stational synthe		I —		
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mem_syn tilt_code				· · · · · · · · · · · · · · · · · · ·
mem_syn_bit_box_brist_fleet mem_syn_bit_box_brist_fleet mem_syn_bit_box_brist_fleet mem_syn_bit_box_brist_fleet mem_syn_bit_box_brist_fleet mem_syn_bit_mem_syn_bi				
itit_code old_wsp_max old_wsp_shift Q_old Vord16 Q_max Word16[2] gp_clip qua_gain word16[2] qua_gain word16[2] qua_gain word16[2] qua_gain word16[4] dol_mord16 ol_gain dol_mord16 ol_wsp_tlfq vord16 ol_wspt_flg vord16[4] ol_wspt_flg vord16 ol_wspt_flg vord16 ol_wspt_flg vord16 ol_wspt_flg vord16 ol_dol_lag word16[5] old_ol_lag word16[5] old_ol_lag word16[5] old_ol_lag word16[6] vord16 ol_wspt_flg vord16 ol_wspt_flg vord16 ol_wspt_flg vord16[5] old_ol_lag word16[5] old_ol_lag word16[5] old_ol_lag word16[6] vord16[6] mem_syn_bi word16[16] mem_deemph mem_syn_bi word16[16] mem_deemph mem_syn_bi word16[6] mem_b400 mem_oversamp word16[6] mem_h20 word16[16] mem_h12 word16[16] mem_h13 word16[16] mem_h143 word16[16] vord16[16] vord16[16] mem_h153 word16[16] vord16[16] v				
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old_wsp_shift Q_old Word16 Q_max Word16[2] Word16[2] Maximum scaling factor Old scaling factor Maximum scaling factor Maximum scaling factor memory of pitch clipping qua_gain Word16[4] Old_T0_med Word16 Vord16 Olgain Word16 Olgain Word16[5] Open-loop gain Word16[5] Open-loop lag gain filter memory Word16[5] Open-loop lag gain filter memory Vord16[243] Vord16[7] Vord				
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old_T0_med ol_gain				
ol_gain ada_w vord16 vo				
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hp_wsp_mem Word16[9] Open-loop lag gain filter memory old_hp_wsp word16[243] Open-loop lag open-lo		ol_wght_flg		switches lag weighting on and off
old_hp_wsp vadSt vadSt dtx_encSt dtx_encSt dtx_encState* first_frame lsfold Word16[16] L_gc_thres Word16 Word16[16] Word16[16] L_gc_thres Word16 Word16[16] Word16[16] Word16[16] wem_syn_lo word16[16] word16[16] wem_syn_lo word16[16] wem_deemph Word16 mem_sig_out word16[6] mem_oversamp word16[6] mem_syn_ff word16[16] word16[16] wem_hp400 word16[16] wem_syn_ff word16[16] wem_syn_ff word16[16] wem_hf3 word16[30] word16[30] mem_hf3 word16[30] lnput BP filter memory (23.85 kbit/s mode) lnput BP filter memory (23.85 kbit/s mode) word16[30] lnput LP filter memory (23.85 kbit/s mode) lnput LP filter memory (23.85 kbit/s mode) word16[30] lnput LP filter memory (23.85 kbit/s mode) word16[30] lnput LP filter memory (23.85 kbit/s mode) lnput lnp		old_ol_lag	Word16[5]	Open loop lag history
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L_gc_thres mem_syn_hi mem_syn_lo word16[16] mem_syn_lo mem_deemph mem_deemph mem_deemph mem_sig_out mem_hp400 mem_oversamp mem_syn_hf mem_syn_hf mem_syn_hf mem_syn_hf mem_oversamp mem_syn_hf mem_hf mem_hf mem_hf mem_hf2 mem_hf2 mem_hf3 word16[30] seed2 word16[30] seed2 word16 disp_mem word16[30] seed2 word16 disp_mem word16[30] seed2 word16 disp_mem word16[30] seed2 word16 disp_mem word16[30] seed3 word16 disp_mem word16[30] word16[8] word16 disp_mem word16 disp_men word16 disp_men word16 disp history distances logarithmic energy comfort noise excitation seed D word16[28] sumD word16[28] Sum of ISF history distances is decreased in DTX hangover period counter for elapsed speech frames in DTX background noise estimate ave_level word16[12] word16[12] sub_level word16[12] word16[12] input levels of the previous frame input levels calculated at the end of a frame (lookahead) memory for the filter memory (least significant word genthes inglificant word genthesis filter memory her mem_syn_the plenthesis filter memory her filter memory least significant word her memory her filter memory least significant word her filter memory least significant word16[12] word16[1		first_frame	Word16	First frame indicator
mem_syn_hi mem_syn_lo mem_syn_lo mem_syn_lo mem_syn_lo mem_syn_lo mem_sig_out mem_sig_out mem_h400 mem_oversamp mem_syn_hf word16[30] mem_hf2 mem_hf3 word16[30] mem_hf3 seed2 word16 disp_mem word16[30] mem_hf3 word16[30] memory (23.85 kbit/s mode) lnput BP filter memory (23.85 kbit/s mode) lnput LP filter memory (23.85 kbit/s mode) lnput LP filter memory (23.85 kbit/s mode) lnput LP filter memory (23.85 kbit/s mode) lnput BP filter memory (23.85 kbit/s mode) lnput LP filter memory (23.85 kbit/s mode) lnput BP filter memory (23.85 kbit/s mode) lout P fi		Isfold	Word16[16]	Old ISF vector
mem_syn_hi mem_syn_lo mem_syn_lo mem_syn_lo mem_syn_lo mem_syn_lo mem_sig_out mem_sig_out mem_h400 mem_oversamp mem_syn_hf word16[30] mem_hf2 mem_hf3 word16[30] mem_hf3 seed2 word16 disp_mem word16[30] mem_hf3 word16[30] memory (23.85 kbit/s mode) lnput BP filter memory (23.85 kbit/s mode) lnput LP filter memory (23.85 kbit/s mode) lnput LP filter memory (23.85 kbit/s mode) lnput LP filter memory (23.85 kbit/s mode) lnput BP filter memory (23.85 kbit/s mode) lnput LP filter memory (23.85 kbit/s mode) lnput BP filter memory (23.85 kbit/s mode) lout P fi		L_gc_thres	Word16	Noise enhancer threshold
mem_deemph mem_sig_out mem_hp400 mem_syo_hf mem_syn_hf mem_syn_hf mem_syn_hf mem_hf mem_hf2 mem_hf3 seed2 disp_mem word16[8] Word16[8] Word16[8] Word16[30] mem_hf3 seed2 Word16 disp_mem word16[8] Word16[8] Word16[8] Word16[8] Word16 Gain_alpha Word16 Word16[8] Word16 Word16[8] Word16 Word			Word16[16]	synthesis filter memory (most significant word)
mem_sig_out mem_hp400 mem_oversamp mem_oversamp mem_syn_hf mem_syn_hf mem_hf Mord16[2*12] Mord16[30] mem_hf Mord16[30] mem_hf2 mem_hf3 Mord16[30] mem_hf3 Mord16[30] mem_hf3 Mord16[30] mem_hf4 Mord16[30] mem_hf5 Mord16[30] mem_hf6 Mord16[30] mem_hf1 Mord16[30] mem_hf2 Mord16[30] mem_hf3 Mord16[30] mem_hf3 Mord16[30] mem_hf4 Mord16[30] mem_hf4 Mord16[30] mem_hf5 Mord16[30] mem_hf3 Mord16[30] mem_hf4 Mord16[30] mem_hf4 Mord16[30] mem_hf5 Mord16[30] mem_hf4 Mord16[30] mem_hf4 Mord16[30] mem_hf4 Mord16[30] mem_hf5 Mord16[30] mem_hf4 Mord16[30] mem_oversamp impiter memory (23.85 kbit/s mode) Input LP filter memory Mord16[8] VAD history It Sp history It Sp history It Sp history (8 frames) Iogarithmic frame energy history (8 frames)		mem_syn_lo	Word16[16]	synthesis filter memory (least significant word)
mem_sig_out mem_hp400 mem_oversamp mem_oversamp mem_syn_hf mem_syn_hf mem_hf Mord16[16] Mem_oversamp mem_syn_hf mem_syn_hf mem_hf Word16[16] Mord16[16] Mord16[12] Mo			Word16	
mem_oversamp mem_syn_hf mem_syn_hf mem_hf Mord16[30] mem_hf2 Word16[30] mem_hf2 Word16[30] mem_hf3 Seed2 Word16 disp_mem Word16[8] Word16[8] Word16[8] Word16[8] Word16[8] Word16 Mord16[8] Word16 Mord16[8] Word16 Mord16		mem_sig_out	Word16[6]	HP filter memory in the synthesis
mem_oversamp mem_syn_hf mem_syn_hf mem_hf2 Word16[30] mem_hf2 Word16[30] mem_hf3 seed2 disp_mem Vord16[8] Word16[8] Vord16[8] Vord16[8] Vord16[8] Vord16[8] Vord16[8] Vord16[8] Vord16[8] Vord16 Gain_alpha Word16[128] Log_en_hist Log_en_index Cng_seed Word16 D Word16[8] Word16 D Word16[8] Word16 D Word16 D Word16[8] Word16 D Word16 D Word16 D Word16 D Word16 D Word16[8] Word16 D W		mem_hp400	Word16[6]	HP filter memory
mem_syn_hf mem_hf mem_hf Word16[30] mem_hf2 Word16[30] mem_hf3 seed2 Word16 disp_mem Word16[8] Word16[8] Word16[8] Word16 Gain_alpha Word16[128] Log_en_hist Log_en_index Cng_seed Word16 D Word16[8] Word16[8] Word16 D Word16[8] Word16[8] Sum of ISF history distance matrix Sum of ISF history distances dtxHangoverCount decAnaElapsedCount Word16 decAnaElapsedCount Word16[12] word16		-	Word16[2*12]	Oversampling filter memory
mem_hf mem_hf2 mem_hf3 word16[30] mem_hf3 seed2 disp_mem word16[8] word16 Gain_alpha word16 Word16[8] word16 Word16 Gain_alpha word16 Word16[8] word16 Word16 Gain_alpha word16 Word16 Word16 Word16 Gain_alpha word16 Word		-		
mem_hf2 mem_hf3 seed2 disp_mem Word16[30] word16 disp_mem Word16[8] word16 Gain_alpha tx_encState Isf_hist				Estimated BP filter memory (23.85 kbit/s mode)
mem_hf3 seed2 disp_mem vad_hist Gain_alpha Word16[8] Word16 D Word16 D Word16 D Word16 Word16 D Word16 D Word16 D Word16 D Word16 Word16 D				• ` ` ` ` ` ` ` ` ` ` ` ` ` ` ` ` ` ` `
seed2 disp_mem vad_hist Gain_alpha Word16 D Word16 D Word16 Word16 D Word16 Word16 Word16 D Word16 Word16 Word16 Word16 Word16 D Word16 Word16 D Word16 Word16 Word16 D Word16 Word16 D Word16 Wo				
disp_mem vad_hist Word16 Word1				
vad_hist Gain_alpha Word16 Word16 Word16 Word16 Word16 Word16 Word16 Word16 Word16 Isf_hist Log_en_hist Word16[8] Hist_ptr Word16 Cng_seed Word16 D Word16[28] SumD dtxHangoverCount decAnaElapsedCount Word16 Word				
Gain_alpha Word16 Higher band gain weighting factor (23.85 kbit/s mode) Itx_encState Isf_hist Log_en_hist Hist_ptr Log_en_index Cng_seed D Word16[28] Word16 D Word16[28] SumD dtxHangoverCount decAnaElapsedCount AdState1 Bokr_est ave_level old_level sub_level Qain_alpha Word16 Higher band gain weighting factor (23.85 kbit/s mode) LSP history (8 frames) logarithmic frame energy history (8 frames) logarithmic frame energy history vectors lndex for logarithmic energy Comfort noise excitation seed ISF history distance matrix Sum of ISF history distances is decreased in DTX hangover period counter for elapsed speech frames in DTX background noise estimate averaged input components for stationary esti input levels of the previous frame (lookahead) a_data5 Word16[5][2] memory for the filter bank		i		
dtx_encState Isf_hist			Word16	
Itx_encState Isf_hist Log_en_hist Hist_ptr Log_en_index Cng_seed D Word16[28] Word16[28] Word16 D Word16[28] SumD Word16[8] Word16 Wo				
Log_en_hist Hist_ptr Log_en_index Cng_seed D Word16[8] Word16 D Word16[28] Word16 D Word16[28] Sum of ISF history distance matrix SumD dtxHangoverCount decAnaElapsedCount Word16 D Word16[12] word16[12] old_level Sub_level Word16[12] a_data5 Word16[5][2] Word16[8] Wo	ltx encState	Isf hist	Word16[128]	
Hist_ptr Log_en_index Cng_seed D Word16 Word16 D Word16[28] Sum of ISF history distance matrix SumD dtxHangoverCount decAnaElapsedCount bckr_est ave_level old_level Sudta6 Word16[12] word16[12] sub_level Word16[12] a_data5 Word16[5][2] word16[5][2] pointer to the cyclic history vectors Index for logarithmic energy Comfort noise excitation seed ISF history distance matrix Sum of ISF history distances is decreased in DTX hangover period counter for elapsed speech frames in DTX background noise estimate averaged input components for stationary esti input levels of the previous frame input levels calculated at the end of a frame (lookahead) memory for the filter bank				
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decAnaElapsedCount Word16 counter for elapsed speech frames in DTX				
bckr_est ave_level word16[12] background noise estimate ave_level word16[12] averaged input components for stationary esting input levels of the previous frame input levels calculated at the end of a frame (lookahead) a_data5 word16[5][2] memory for the filter bank				
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old_level	radolalo i			
sub_level Word16[12] input levels calculated at the end of a frame (lookahead) a_data5 Word16[5][2] memory for the filter bank				
a_data5 Word16[5][2] (lookahead) memory for the filter bank				
a_data5 Word16[5][2] memory for the filter bank		Sub_ievei	VV 010 10[12]	
		a data5	Word16[5][2]	
		-		
burst_count Word16 counts length of a speech burst		a_data3		

Struct name	Variable	Type[Length]	Description
	Hang_count	Word16	hangover counter
	Stat_count	Word16	stationary counter
	Vadreg	Word16	15 flags for intermediate VAD decisions
	Tone_flag	Word16	15 flags for tone detection
	sp_est_cnt	Word16	Speech level estimation counter
	Sp_max	Word16	Maximum signal level
	sp_max_cnt	Word16	Maximum level estimation counter
	Speech_level	Word16	Speech level
	prev_pow_sum	Word16	Power of previous frame

Table 8: Speech decoder static variables

Struct name	Variable	Type[Length]	Description
Decoder_State	old_exc	Word16[248]	excitation vector
	ispold	Word16[16]	Old ISP vector
	isfold	Word16[16]	Old ISF vector
	isf_buf	Word16[48]	ISF vector history
	past_isfq	Word16[16]	past quantized ISF prediction error
	tilt_code	Word16	Preemhasis filter memory
	Q_old	Word16	Old scaling factor
	Qsubfr	Word16	Scaling factor history
	L_gc_thres	Word16	Noise enhancer threshold
	mem_syn_hi	Word16[16]	synthesis filter memory (most significant word)
	mem_syn_lo	Word16[16]	synthesis filter memory (least significant word)
	mem_deemph	Word16	Deemphasis filter memory
	mem_sig_out	Word16[6]	HP filter memory in the synthesis
	mem_oversamp	Word16[24]	Oversampling filter memory
	mem_syn_hf	Word16[20]	Higher band synthesis filter memory
	mem_hf	Word16[30]	Estimated BP filter memory (23.85 kbit/s mode)
	mem_hf2	Word16[30]	Input BP filter memory (23.85 kbit/s mode)
	mem_hf3	Word16[30]	Input LP filter memory (23.85 kbit/s mode)
	seed	Word16	Random code generation seed for bad frames
	seed2	Word16	Random generation seed for higher band
	old_T0	Word16	Old LTP lag (integer part)
	old_T0_frac	Word16	Old LTP lag (fraction part)
	lag_hist	Word16[5]	LTP lag history
	dec_gain	Word16[23]	Gain decoding memory
	seed3	Word16	Random LTP lag generation seed for bad frames
	disp_mem	Word16[8]	Phase dispersion memory
	mem_hp400	Word16[6]	HP filter memory
	prev_bfi	Word16	Previous BFI
	state	Word16	BGH state machine memory
	first_frame	Word16	First frame indicator
	dtx_decSt	dtx_decState*	see below in this table
	Vad_hist	Word16	VAD history
dtx_decState	Since_last_sid	Word16	number of frames since last SID frame
	true_sid_period_inv	Word16	inverse of true SID update rate
	log_en	Word16	logarithmic frame energy
	old_log_en	Word16	previous value of log_en
	isf	Word16[16]	ISF vector
	lsf_old	Word16[16]	Previous ISF vector
	Cng_seed	Word16	Comfort noise excitation seed
	Isf_hist	Word16[128]	ISF vector history (8 frames)
	Log_en_hist	Word16[8]	logarithmic frame energy history
	Hist_ptr	Word16	index to beginning of LSF history
	dtxHangoverCount	Word16	counts down in hangover period
	DecAnaElapsedCount		counts elapsed speech frames after DTX
	sid_frame	Word16	flags SID frames
	valid_data	Word16	flags SID frames containing valid data
	log_en_adjust	Word16	mode-dependent frame energy adjustment
	dtxHangoverAdded	Word16	flags hangover period at end of speech
	dtxGlobalState	Word16	DTX state flags
	data_updated	Word16	flags CNI updates
	Jaara_upaarea	******	mago or in apadico

5 Homing procedure

The principles of the homing procedures are described in [2]. This specification only includes a detailed description of the 9 decoder homing frames. For each AMR-WB codec mode, the corresponding decoder homing frame has a fixed set of parameters. The parameters in serial format are packed into parameters in 15-bit-long format where the first serial bit is inserted into most significant bit in the 15-bit-long format. These 15-bit-long parameters do not represent real speech parameters, but they decrease memory consumption compared to the speech parameters. Table 9 shows the homing frame in 15-bit-long format for different modes. In the decoder, the received speech parameters in serial format are first converted into 15-bit-long format. Then the obtained parameters are compared against the homing frame table values (Table 9).

Table 9: Table values for the decoder homing frame in 15-bit-long format for different modes

Mode	Value (MSB=b0)
0	3168, 29954, 29213, 16121, 64, 13440, 30624, 16430, 19008
1	3168, 31665, 9943, 9123, 15599, 4358, 20248, 2048, 17040, 27787, 16816, 13888
2	3168, 31665, 9943, 9128, 3647, 8129, 30930, 27926, 18880, 12319, 496, 1042, 4061, 20446, 25629, 28069, 13948
3	3168, 31665, 9943, 9131, 24815, 655, 26616, 26764, 7238, 19136, 6144, 88, 4158, 25733, 30567, 30494, 221, 20321, 17823
4	3168, 31665, 9943, 9131, 24815, 700, 3824, 7271, 26400, 9528, 6594, 26112, 108, 2068, 12867, 16317, 23035, 24632, 7528, 1752, 6759, 24576
5	3168, 31665, 9943, 9135, 14787, 14423, 30477, 24927, 25345, 30154, 916, 5728, 18978, 2048, 528, 16449, 2436, 3581, 23527, 29479, 8237, 16810, 27091, 19052, 0
6	3168, 31665, 9943, 9129, 8637, 31807, 24646, 736, 28643, 2977, 2566, 25564, 12930, 13960, 2048, 834, 3270, 4100, 26920, 16237, 31227, 17667, 15059, 20589, 30249, 29123, 0
7	3168, 31665, 9943, 9132, 16748, 3202, 28179, 16317, 30590, 15857, 19960, 8818, 21711, 21538, 4260, 16690, 20224, 3666, 4194, 9497, 16320, 15388, 5755, 31551, 14080, 3574, 15932, 50, 23392, 26053, 31216
8	3168, 31665, 9943, 9134, 24776, 5857, 18475, 28535, 29662, 14321, 16725, 4396, 29353, 10003, 17068, 20504, 720, 0, 8465, 12581, 28863, 24774, 9709, 26043, 7941, 27649, 13965, 15236, 18026, 22047, 16681, 3968

6 File formats

This section describes the file formats used by the encoder and decoder programs. The test sequences defined in [1 also use the file formats described here.

6.1 Speech file (encoder input / decoder output)

Speech files read by the encoder and written by the decoder consist of 16-bit words where each word contains a 14-bit, left aligned speech sample. The byte order depends on the host architecture (e.g. MSByte first on SUN workstations, LSByte first on PCs etc.). Both the encoder and the decoder program process complete frames (of 320 samples) only.

This means that the encoder will only process n frames if the length of the input file is n*320 + k words, while the files produced by the decoder will always have a length of n*320 words.

6.2 Mode control file (encoder input)

The encoder program can optionally read in a mode control file which specifies the encoding mode for each frame of speech processed. The file is a text file containing one number per speech frame. Each line contains one of the mode numbers 0-8.

6.3 Parameter bitstream file (encoder output / decoder input)

The files produced by the speech encoder/expected by the speech decoder contain an arbitrary number of frames in the following available formats.

NOTE ON DEFAULT 3GPP AND ITU BITSTREAM FORMATS:

ITU stream format gives very limited possibilities to distinguish NO_DATA and SID_FIRST frame types at the beginning of a stream. In some very limited cases for which some instance between encoder and decoder cuts of the first hangover period frames (e.g. handovers, editing of the stream), the output of the decoder is different depending on the stream format, ITU or default 3GPP.

Default 3GPP format:

This is the default format used in 3GPP. This format shall be used when the codec is tested against the test vectors.

TYPE_OF_FRAME_TYPE	FRAME_TYPE	MODE	B1	B2	•••	Bnn

Each box corresponds to one Wordl6 value in the bitstream file, for a total of 3+nn words or 6+2nn bytes per frame, where nn is the number of encoded bits in the frame. Each encoded bit is represented as follows: Bit 0 = 0xff81, Bit 1 = 0x007f. The fields have the following meaning:

TYPE_OF_FRAME	E_TYPE transmit TX_TYPE RX_TYPE	(0x	type, (6b21) (6b20)	which	is	one	of
If TYPE_OF_FF	RAME_TYPE is TX	TYPE,					
FRAME_TYPE	transmit fi TX_SPEECI TX_SID_F: TX_SID_U: TX_NO_DA	H (0x IRST (0x PDATE (0x	type, (0000) (0001) (0002) (0003)	which	is	one	of
If TYPE_OF_FF	RAME_TYPE is RX	TYPE,					
FRAME_TYPE	RX_SPEECI	H_GOOD (0x H_PROBABLY H_LOST (0x H_BAD (0x ERST (0x PDATE (0x	type, (0000) _DEGRADED (0002) (0003) (0004) (0005) (0006) (0007)	which (0x0001)	is	one	of
B0B2nn	speech encoder value 0x0081 (f		•			either has	the
MODE_INFO	6.60 kb: 8.85 kb: 12.65 kb: 14.25 kb: 15.85 kb: 18.25 kb: 19.85 kb:	inde in index it/s mode	formation, (0x0000) (0x0001) (0x0002) (0x0003) (0x0004) (0x0005) (0x0006) (0x0007)	which	is	one	of

As indicated in section 6.1 above, the byte order depends on the host architecture.

23.85 kbit/s mode

ITU format (activated with command line parameter -itu)

SYNC_WORD	DATA_LENGTH	B1	B2	•••	Bnn

Each box corresponds to one Word16 value in the bitstream file, for a total of 2+nn words or 4+2nn bytes per frame, where nn is the number of encoded bits in the frame. Each encoded bit is represented as follows: Bit 0 = 0x007f, Bit 1 = 0x0081. The fields have the following meaning:

SYNC_WORD

Word to ensure correct frame synchronization between the encoder and the decoder. It is also used to indicate the occurrences of bad frames.

In the encoder output: (0x6b21)

In the decoder input: Good frames (0x6b21)

Bad frames (0x6b20)

DATA LENGTH

Length of the speech data. Codec mode and frame type is extracted in the decoder using this parameter:

DATA _LENGTH	PREVIOUS FRAME	CODEC MODE	FRAMETYPE
0	RX_SPEECH_GOOD/ RX_SPEECH_LOST	DTX	RX_SID_FIRST
0	OTHER THAN RX_SPEECH_GOOD/ RX_SPEECH_LOST	DTX	RX_NO_DATA
35	-	DTX	RX_SID_UPDATE
132	-	6.60 kbit/s	RX_SPEECH_GOOD/ RX_SPEECH_LOST
177	-	8.85 kbit/s	RX_SPEECH_GOOD/ RX_SPEECH_LOST
253	-	12.65 kbit/s	RX_SPEECH_GOOD/ RX_SPEECH_LOST
285	-	14.25 kbit/s	RX_SPEECH_GOOD/ RX_SPEECH_LOST
317	-	15.85 kbit/s	RX_SPEECH_GOOD/ RX_SPEECH_LOST
365	-	18.25 kbit/s	RX_SPEECH_GOOD/ RX_SPEECH_LOST
397	-	19.85 kbit/s	RX_SPEECH_GOOD/ RX_SPEECH_LOST
461	-	23.05 kbit/s	RX_SPEECH_GOOD/ RX_SPEECH_LOST
477	-	23.85 kbit/s	RX_SPEECH_GOOD/ RX_SPEECH_LOST

MIME/file storage format (activated with command line parameter -mime)

Detailed description of the AMR-WB single channel MIME/file storage format can be found in [7] (sections 5.1 and 5.3). This format is used e.g. by the Multimedia Messaging Service (MMS).

Annex A (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment		New
03-2001	11	SP-010083			Version 2.0.0 provided for approval		5.0.0
06-2001	12	SP-010307	001	1	Unnecessary printing in Az_isp-function		5.1.0
06-2001	12	SP-010307	002	1	Overflow in isp_az.c		5.1.0
06-2001	12	SP-010307	003	1	Error in the ISF extrapolation in 6.60 kbit/s mode	5.0.0	5.1.0
06-2001	12	SP-010307	004	1	14-bit masking to decoder	5.0.0	5.1.0
06-2001	12	SP-010307	005	1	Correction of the homing function	5.0.0	5.1.0
06-2001	12	SP-010307	006	1	Fixed codebook initialisation	5.0.0	5.1.0
06-2001					Minor editorial to cover page	5.1.0	5.1.1
09-2001	13	SP-010455	007		Error in the C-code of the encoder homing function	5.1.1	5.2.0
09-2001	13	SP-010455	800		Inconsistency in the file format description	5.1.1	5.2.0
12-2001	14	SP-010699	009		Incorrect mode usage during DTX	5.2.0	5.3.0
12-2001	14	SP-010699	010		Correction of decoder homing function for 23.85 kbit/s mode		5.3.0
03-2002	15	SP-020081	011	2	Correction of mode reading and memory usage	5.3.0	5.4.0
03-2002	15	SP-020081	012		Correction of pitch calculation of AMR-WB encoder	5.3.0	5.4.0
03-2002	15	SP-020081	013		Error concealment of high band gain in 23.85 kbit/s mode	5.3.0	5.4.0
12-2002	18	SP-020692	014		Correction of ambiguous expression in the AMR-WB C-Code	5.4.0	5.5.0
03-2003	19	SP-030089	015	2	Harmonization of 3GPP TS 26.173 and ITU-T G.722.2 C-codes	5.5.0	5.6.0
03-2003	19	SP-030089	016		Correction for handling of RX_NO_DATA frames	5.5.0	5.6.0
06-2003	20	SP-030216	017	1	MMS compatible input/output option for fixed-point AMR-WB source code	5.6.0	5.7.0
					Added file containing the C-code accidentally omitted from previous version	5.7.0	5.7.1
09-2003	21	SP-030446	019		Possible decoder LPC coefficients overflow	5.7.1	5.8.0
12-2004	26	SP-040844	020	1	Incorrect definition of vector nb_of_bits 5		6.0.0
12-2006	34	SP-060846	0023	1	Correction to bug in ITU-T bitstream format in the presence of frame erasures 6.0.0 6.7		6.1.0
03-2007	35	SP-070023	0025	1	Correct text specification to be aligned with the C-code	6.1.0	6.2.0
09-2007	37	SP-070626	0028	1	Robust operation of AMRWB-decoder	6.2.0	6.3.0

History

	Document history				
V6.0.0	December 2004	Publication			
V6.1.0	December 2006	Publication			
V6.2.0	March 2007	Publication			
V6.3.0	October 2007	Publication			